Hemisphere GPS

R220

User Guide

Part No. 875-0212-000 Rev. A1

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

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Hemisphere GPS Precision GPS Applications

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6,111,549	6,397,147	6,469,663	6,501,346	6,539,303
6,549,091	6,631,916	6,711,501	6,744,404	6,865,465
6,876,920	7,142,956	7,162,348	7,277,792	7,292,185
7,292,186	7,373,231	7,400,956	7,400,294	7,388,539
7,388,539	7,429,952			

Other U.S. and foreign patents pending.

Notice to Customers

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Hemisphere GPS	Telephone number:	(403) 259-3311
4110 9th Street S.E.	Fax number:	(403) 259-8866
Calgary, Alberta, Canada T2G 3C4	E-mail address:	sales@hemispheregps.com

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To the greatest extent possible, this warranty shall be governed by the laws of the State of Arizona. In the event that any provision hereof is held to be invalid by a court of competent jurisdiction, such provision shall be severed from this warranty and the remaining provisions shall remain in full force and effect.

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Hemisphere GPS
8444 N. 90th Street, Suite 130
Scottsdale, AZ 85258
Phone: 480-348-9919 Fax: 480-348-6370
techsupport@hemispheregps.com
www.hemispheregps.com

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1: Introducing the R220

Overview
What's Included
Parts List

Overview

The R220 GPS Receiver is the latest addition to Hemisphere GPS' precision product line. It is ideal for a number of applications including navigation and guidance, land and marine surveying, and machine control and monitoring. It boasts the latest dual frequency technology in the Eclipse board and features fast, reliable, long range RTK (Real Time Kenematic) performance.

The R220 tracks GPS, SBAS and L-Band (OmniSTAR VBS®). It also utilizes Hemisphere GPS' exclusive COAST™ technology, which provides positioning data during differential signal outages.

What's Included

Please look over the parts shipped with your system. If any part appears to have been damaged during shipping, please contact your freight carrier. If any parts are missing, please contact your dealer.

Figure 1-1. R220 system parts diagram.

Parts List

Table 1-1: R220 Series Parts List

Diagram Letter	Part Name	Qty	Part Number
A	CBL, IO-x, DSUB(F)9-DSUB(M)9, 3M	1	050-0011-022
B	CLB, RF-X, TNC(M)-TNC(M), 5M	1	052-0005-000
C	CBL, PWR-X, CIRC(F) 2-PT, 3M	1	054-0009-000
D	KIT, MOUNTING, R100	1	710-0056-000
E	MNL, USER.GUIDE, ECLIPSE.R220	1	875-0212-000
F	ASSY, A-SERIES.ANTENNA, MNT, AG	1	720-0033-00A
G	CBL, IO-X, USB A-USB A, 3M	1	051-0192-000#
H	L1/L2, GPS L-BAND, ANTENNA	1	804-3035-000
I	ECLIPSE GPS RECVR, R220,USB	1	802-1048-000#

2: Installing the R220

Mounting the Receiver
Mounting the Antenna
Connecting the Cables
Connecting R220 to External Devices
USB Data Logging

Introduction

The R220 is easily set up for operation. This chapter provides information on the following topics:

- Mounting the receiver
- Mounting the antenna
- Cable interface
- Connecting the cable to other devices

Mounting the Receiver

R220 Placement

While it is not necessary to mount the R220, should you decide to do so, you have several options. When choosing a mounting location, please ensure the menu screen, LEDs and buttons are visible and accessible. Please also ensure access to the back panel is available for switching out cables and accessing the power button. There is an option within the menu system to switch the direction of the display. If it is easier to mount the unit upside down, it can be mounted this way and still operate the display easily.

Note: When mounting the R220, mount the unit inside and away from the elements and in a location that minimizes vibration, shock, extreme temperatures and moisture.

Several thumb screws, nuts and brackets are provided to mount the R220.

To install the brackets for mounting:

1. Slide the nuts through the openings along the sides of the receiver.
2. Place the bracket alongside the receiver and insert the thumbscrews so they screw into the nuts.
3. Screw down the brackets.

Mounting the Antenna

Placement of the antenna is crucial to the system's operation. The GPS receiver inside the R220 computes a position based upon measurements from each satellite to the phase center of the antenna. Mount the antenna in the location where the reference position should be. When choosing a location to mount the antenna, make sure it has a clear view of the sky. This will ensure that the GPS satellite signals are not obstructed, which can reduce the system's performance.

When mounting the antenna try to:

Mount the antenna on, or as close to, the center of the point of measurement, and position the antenna as high as possible.

There are two ways to mount the antenna; magnetic mount or pole mount.

Magnetic Mount

The magnetic mount can be screwed into the bottom of the antenna and mounts to metal surfaces. A metal disc and foam adhesive are included with each magnetic mount. Use the foam adhesive to bond the metal disc to the desired mounting location if there are no metal surfaces. To use the metal disc and foam adhesive:

1. Clean and dry the mounting surface on the vehicle or vessel.
2. Remove the backing from one side of the foam adhesive and press the metal plate onto the mounting surface on the vehicle.
3. Remove the backing from the other side of the foam adhesive.
4. Press the metal plate onto the mounting surface on the vehicle.
5. Apply firm pressure to ensure good adhesion.
6. Place the antenna on top of the metal disc.

Pole Mount

The center thread of the antenna is 5/8 inches for compatibility with a survey pole (not included). Simply thread the pole into the antenna.

Connecting the Cables

The power cable must reach an appropriate power source. The data cable may connect to a data storage device, computer or other device that accepts GPS data. The antenna cable must reach from the antenna to the R220 receiver.

When choosing a route for all of the R220 cables:

- Avoid running cables in areas of excessive heat
- Keep cables away from corrosive chemicals
- Do not run the extension cable through door or window jams
- Keep the cables away from rotating machinery
- Do not bend excessively or crimp the cables
- Avoid placing tension on the cables
- Remove unwanted slack from the extension cable at the receiver end
- Secure along the cable route using plastic wraps

Warning!

Improperly installed cables near machinery can be dangerous.

Connecting the R220 to External Devices

The R220 has two serial ports. It also shares Port A with a USB connection. If a valid USB connection is made, messages can be logged to both the serial port A and the USB port. Commands can be sent via the USB if connected or to the serial port if there is no USB connection.. The USB port is designed to be connected to a host device such as a PC. The PC should recognize the R220 as a serial device. A new COM will appear as a valid connection on the PC. Set the communication software to use this new port to access the R220.

The serial ports of the R220 operate at the RS-232C interface level to communicate with external data loggers, navigation systems and other devices. The two serial ports are accessible via the back panel. On the R220 the serial ports are accessible via two DB9 female connectors. Either serial port can also be used for firmware updates. Figure 2-1 displays the numbering for the DB9 connector (female). The associated numbering for the plug connector (male) is a mirror reflection of the scheme shown in Figure 2-1.

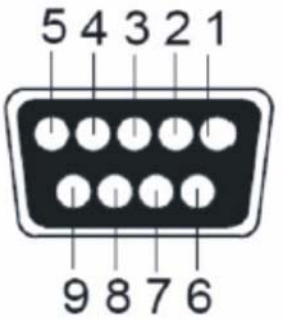


Figure 2-1. DB9 socket numbering

Note: The baud rate for both the R220 serial port and the device to which they are connected must match for successful communication. Table 2-1 on page 13 and Table 2-2 on page 13 provide the pin configuration for the serial ports.

Table 2-1: Port A pin-out, DB9 connector pin number description

Pin	Function
1	Not connected
2	Transmit data Port A
3	Receive data Port A
4	Not connected
5	Signal ground
6	Not connected
7	Not connected
8	Not connected
9	5V output, 350 mA MAX

Table 2-2: Port B pin-out, DB9 connector pin number description

Pin	Function
1	Not connected
2	Transmit data Port B

Table 2-2: Port B pin-out, DB9 connector pin number description

Pin	Function
3	Receive data Port B
4	Not connected
5	Signal ground
6	Event marker
7	Not connected
8	Not connected
9	1 PPS

Serial and USB Ports

The R220 features two serial ports and two USB ports. The ports handle communication to and from the R220. The ports may be configured for a combination of NMEA 0183, binary data and/or RTCM SC-104 data.

The USB configuration of the R220 receiver comprises two USB-A male connectors. Each port has its function marked on the end plate of the receiver.

The port marked “Data Com” is for data communication to the receiver. There is a USB-A to USB-A cable included with your receiver to use with this port. Connect one end of the supplied cable to the receiver and the other end to a host computer. The computer should immediately identify the receiver as a generic serial port and load the appropriate driver. If no appropriate device driver is found, you can download the driver from:

http://www.ftdichip.com/Drivers/VCP.htm

When connecting the R220 USB "Data Com" port to your computer, you will need to install the FTDI drivers, twice. Once the correct drivers are installed, a pop-up will appear in the lower right corner of your computer screen. The pop-up will state that new hardware has been installed on your computer. The hardware is installed as a "Microsoft Serial BallPoint". In order for your computer to recognize the USB "Data Com" port, you need to disable the "Microsoft Serial BallPoint".

Step 1: Go into **Control Panel** and click **Systems**.

Step 2: In the **Systems** window, click on the **Hardware Tab** and then click on **Device Manager**.

Step 3: In the **Device Manager**, select **Mice and other pointing devices** from the tree fields and right-click on **Microsoft Serial BallPoint** and select **disable**.

Note: Do NOT uninstall the Microsoft Serial BallPoint. Uninstalling will only result in reinstallation once the computer has been shut down or restarted.

This USB DATA port automatically switches the PORT-A receive line from the DB9 connector to the USB connector when the USB cable is connected and the Microsoft Serial BallPoint has been disabled. You may still receive data on both USB and PORT-A at the same time and the same baud rate, but only talk to the receiver on the USB port when it is connected. When the USB cable is unplugged, PORT-A will return to normal use.

The second port marked "MEM STICK" is used for data logging onto a USB memory stick. If there is a status LED on your memory stick, it should become active after the receiver has identified the USB memory stick inserted into the connector. For further data logging options on the memory stick, please see the following section on the data logging menu.

If you mistakenly connect the supplied USB-A to USB-A cable into the “MEM STICK” connector or a USB memory stick into the “DATA COM” port, the USB functionality will not work. The ports are not interchangeable. Only when the appropriate device is connected to the appropriate connector will the USB functionality work.

USB Data Logging

Once a USB memory stick has been inserted into the receiver, the data logging menu will show the memory stick free space and allow data logging to begin. A data menu will confirm that your memory stick is logging.

To configure the data stored to the memory stick, enter the “Config” submenu of the main Data Logging menu. You can have the receiver auto-select a file name for you or enter your own filename. If entering your own filename, you may select to append or overwrite an old file of the same name. No additional warnings are given to confirm the overwriting of an old file. If the receiver is auto-generating the file name for logging, it will always generate a name for the file so that no other files are overwritten.

For RAW data logging, you may also want the receiver configuration to be inserted into the file. If this option is selected, the file will start with the receiver configuration comprised of the replies to the $JI, $JK, $JT, and $JSHOW queries. You may also select the data logs to be logged to the file and their respective periods. You can select any number of logs and any period to meet your needs. Keep in mind that the logged data is limited by your receiver subscriptions. You can see your subscription state in the “System Setup” menu by going to the “Software Disc” and then “Authorizations” sub menu.

You can log data to the USB memory stick in Google Earth KML format with latitude, longitude and height, or in a Comma Separated Values (CSV) format with the time, latitude, longitude, and height.

Data files are always stored in the root directory of the memory stick. There is no support for logging to sub-directories.

Note: An authorized code is required to enable the output of the binary 76 data message.

Warning!

Always stop the data log before removing the memory stick from the receiver. Failure to do so may result in a loss of data.

Custom Configuring the R220

All aspects of the R220 may be configured through the serial port with the use of Hemisphere GPS commands. Many aspects of the R220 receiver can be configured. Please refer to Hemisphere GPS' GPS Technical Reference for specific command details.

Note: If you have any questions, contact your local Hemisphere GPS dealer for more information regarding the use of Hemisphere GPS commands and customized configuration.

Environmental Considerations

The R220 receiver is designed to be placed indoors. It is, however, splash proof in case of accidental exposure. The antenna is designed to be used outdoors. See Table B-3 on page 50 of Appendix B, for the environmental specifications.

Note: The changes made to the R220 via the serial port will not be saved to the memory unless a save command is issued ($JSAVE). If changes are made via the menu system, they will automatically be saved.

3: Operating Basics

Starting-Up the R220
Understanding the LEDs
Navigating the Menus

Introduction

The R220 was created for easy operation. This chapter provides information on the following topics:

- How to start the R220
- The LEDs
- The R220's Main Menu and Differential Menu

Starting-Up the R220

To start-up the R220:

1. Connect the ends of the R220 power cable to a power source providing between 8 and 36 VDC. The power supply should be continuous and clean for best performance. Table B-1 on page 40 of Appendix B, provides the R220's power specifications.
2. Turn on the system by pressing the on/off switch on the back panel.
.

Note: Hemisphere GPS suggests that a weather-tight connection and connector be used if the connection will be located outside.

Warning!

Be careful not to provide a voltage higher than the input range (36 VDC). This will damage the receiver and will void the warranty.

Do not attempt to operate the R220 with the fuse bypassed. Such a modification will void the product warranty

The R220 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. With the application of power, the R220 will proceed through an internal start-up sequence, however, it will be ready to communicate immediately.

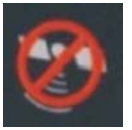
The first start-up can take from 5 to 15 minutes depending on the location. Subsequent start-ups will output a valid position within 1 to 5 minutes depending on the location and time since the last start-up

Note: It can take up to five mintues for the R220 to receive a full ionospheric map from SBAS. Once it receives a complete map, the R220 will operate at optimum accuracy..

Understanding the LEDs

The R220 has three LEDs:

- Power Indicator LED - red. This LED illuminates when the R220 is powered.



- GPS Lock Indicator LED - yellow. This LED remains illuminated once the R220 achieves a solid GPS lock.

- DGPS Position Indicator LED - green. This LED illuminates solid green when the receiver has achieved a differential position and a pseudo range residual of better than the value specified by the $JLIMIT command. (The default is 10.0 meters (32.8 feet)). If the residual value is less than the current threshold, the green LED will blink indicating that differential mode has been attained, but the residual threshold has not been met.

Navigating the Menus

The R220 menu system is designed for easy setup and configuration of the unit in or out of the field. Most configurations can be done entirely through the menu system without having to connect to a computer or PDA. The menu software supports many different languages so that the configuration of the receiver can easily be understood.

Main Menu

There are five sub-menus available on the main menu screen of the R220:

- GPS
- Differential Corrections
- Configuration Wizard
- System Setup
- Data Logging

Menu maps for each sub-menu are included in this section for easy navigation.

Note: To return to the factory default configuration:

Hold down the ENTER key on start-up until the splash screen disappears.

GPS Menu

The GPS menu allows you to view and edit your GPS settings. Settings include the data port outputs, specific positioning parameters, UTC time offset, and satellite visibility and positioning information.

Differential Corrections Menus

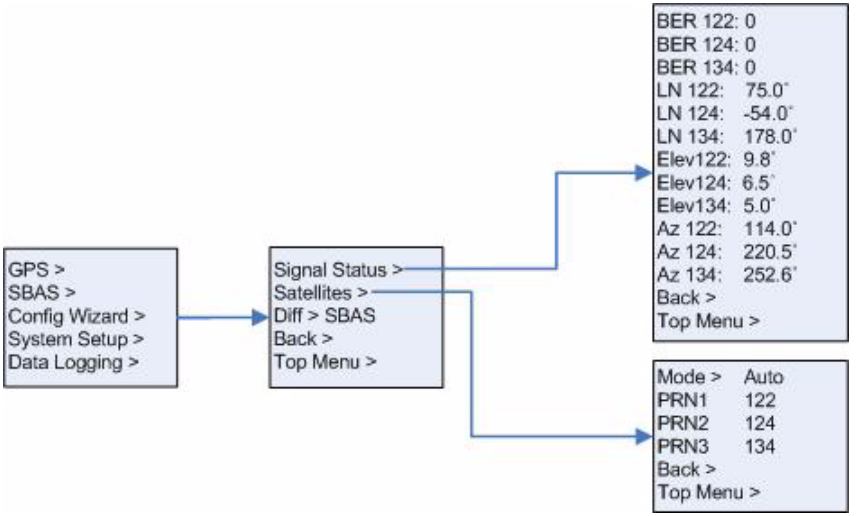
The Differential Corrections menu allows you to view your differential settings. The name of the differential menu shown in the display reflects your current differential source. So, for example, if you are using SBAS, you will see “SBAS” and the associated menu options.

Differential sources available on your unit will vary depending on the model and differential correction subscriptions you may have purchased. Potential options include:

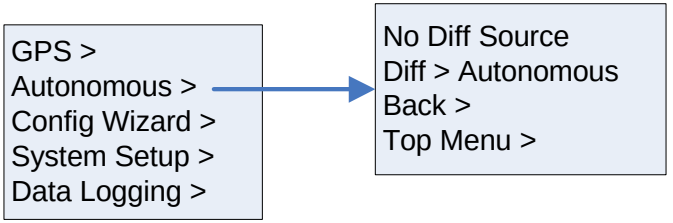
- SBAS
- Autonomous
- Base Station
- L-Dif
- External RTCM

From these menus, you can view your current status or adjust settings.

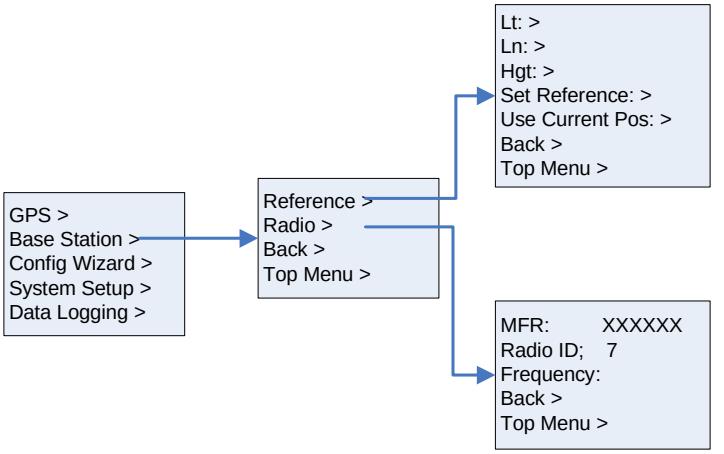
SBAS Menu -



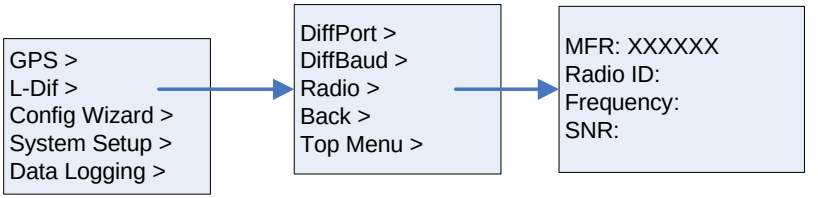
Autonomous Menu -



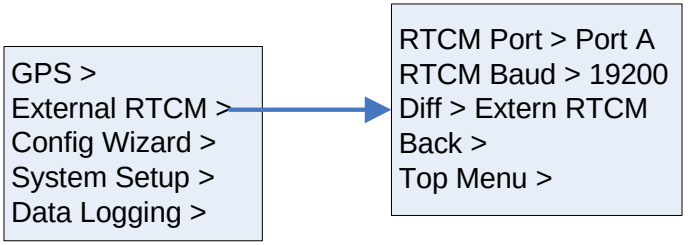
Base Station Menu -



L-Dif Menu -

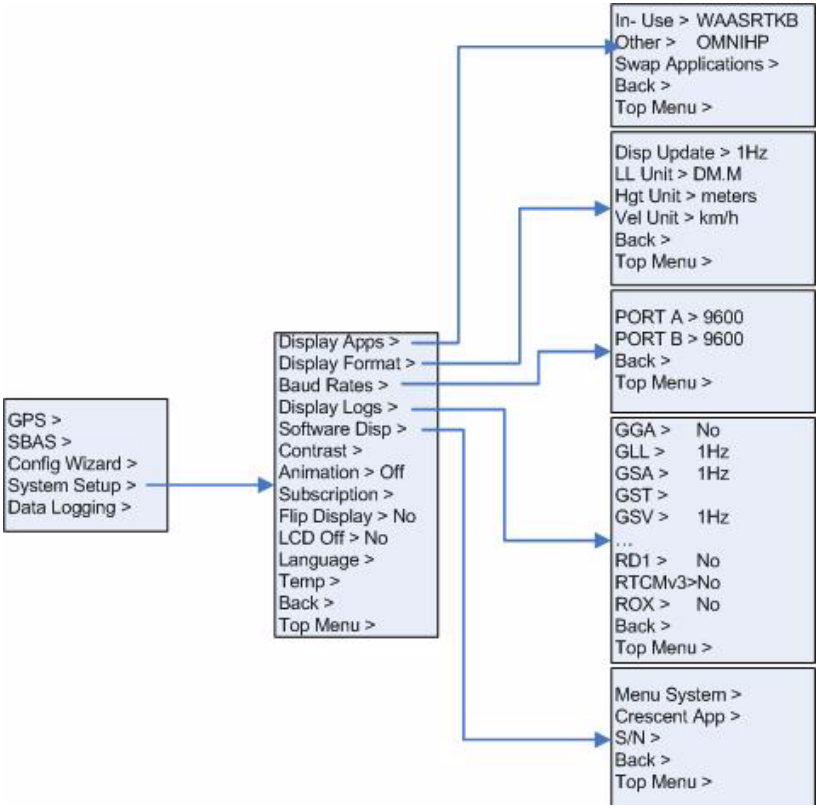


External RTCM Menu -



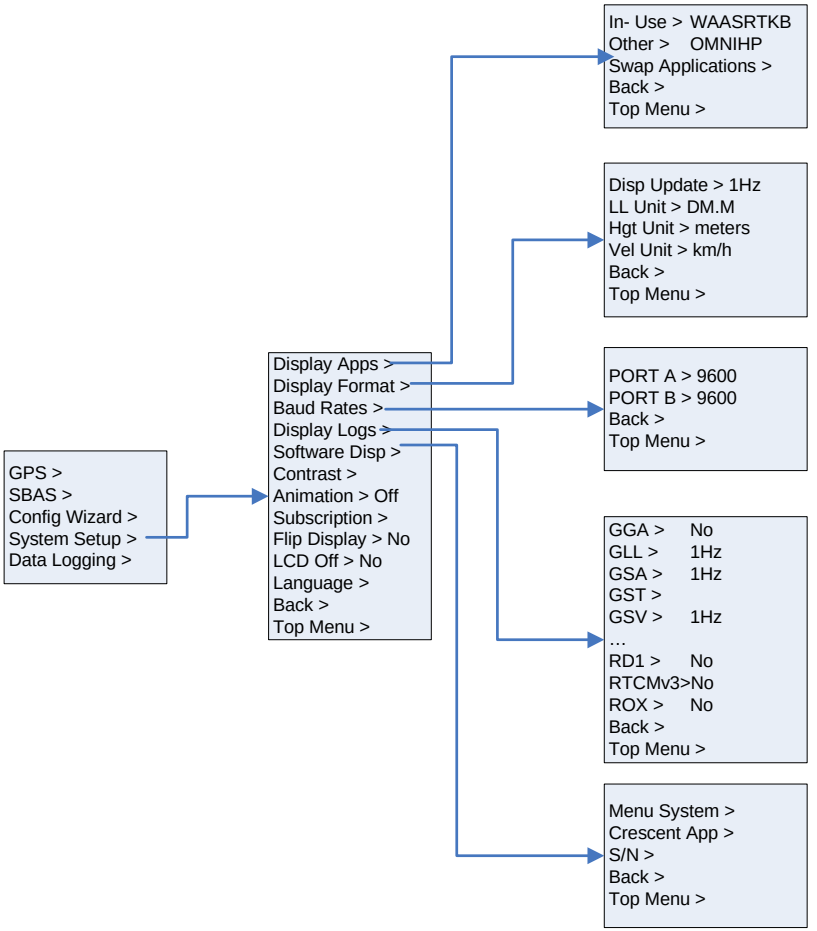
Configuration Wizard Menu

The Configuration Wizard walks you through basic settings to get up and running.



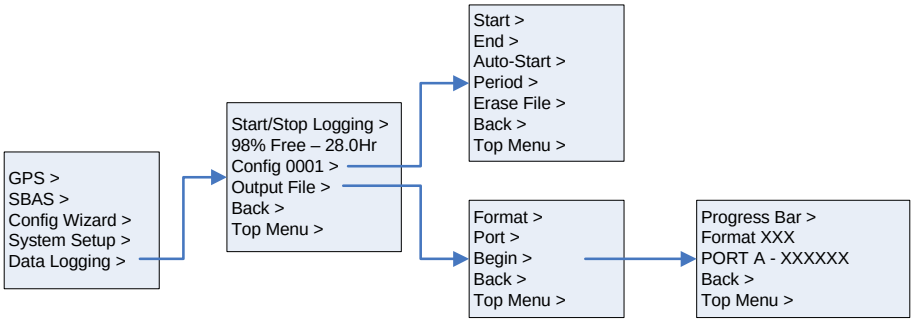
System Setup Menu

The System Setup menu enables you to quickly view and edit current system settings. General settings include such items as current applications, units, baud rates, logs, LED contrast, subscription code, and languages.



Data Logging Menu

The Data Logging menu enables you to log or output job data.



4: Using GPS Differential Corrections

Using RTK/L-Dif

Using OmniSTAR

Using RTK/L-Dif

Introduction

RTK and Local Differential (L-Dif) are two differential options for the R220 that provide the most precise accuracy. A local base station is required for both differential options. Most commonly, the base station is comprised of a GPS receiver, GPS antenna, radio transmitter and power source (such as available in the Outback BaselineHD). The base station is typically set up near the working area, tracks GPS signals and broadcasts differential corrections to a radio and rover GPS receiver. The rover GPS system processes the corrections and outputs very accurate position information.

Installing the Base Station

To set up the base station:

1. Place the base station at a location with no obstructions between the rover radio and base station. (See to Figure 4-1 and 4-2 on pages 37 and 38.)

Figure 4-1. Base station on tripod

Note: Do not place the base station near metal objects.

Make sure the base station is at least 50 meters (160 feet) from obstructions.. (See Figure 4-2 on page 38.)

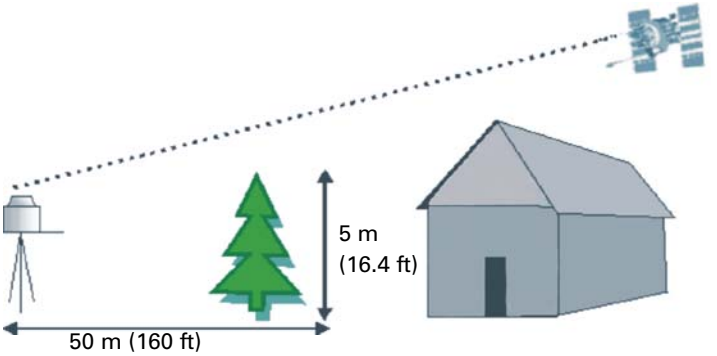


Figure 4-2. Location of base station

Installing the Rover Radio

Note: Make sure the rover radio and the GPS antenna are at least 1 meter (3 feet) from each other.

The GPS antenna must not be blocked by the rover radio.

The rover radio must receive regular corrections from the base station, every one to two seconds (differential age), for up to 15 minutes to achieve RTK lock (maximum accuracy). Typically, a lock is achieved in under five minutes.

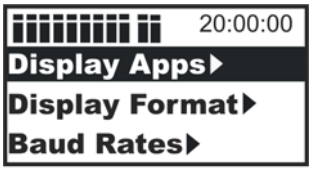
Using the R220 as a Base Station or Rover

The R220 can be used as a base station or rover receiver, but requires a subscription. Running a base and rover together requires a link between the two in order to transfer the differential corrections. The link can be wired or wireless (i.e. radio modem). The corrections must be transferred to the rover receiver through the desired link.

To set up the proper application:

1. Make sure the current R220 application is set to WAASRTKB for a base station, or RTK for a rover, by using the interface on the front panel.
2. Scroll down to **System Setup>**.
3. Press the ENTER button to enter the **System Setup** menu.

4. Select **Display Apps>** and press the ENTER button to enter the **Display Applications** screen.



Make sure that **In Use:** displays either **WAASRTKB** for a RTK or L-Dif base station or **RTK** for a RTK or L-Dif rover receiver. If the **RTK** application only appears as **Other:**, scroll down and select **SWAP APPLICATIONS**. The desired application will be shown as **In Use**.

Note: To obtain RTK readings you must have RTK Rover and RTK Base set on your R220.

Connecting the R220 to a PC - This application selection can also be done by using a terminal program, such as HyperTerminal®, SLXMon or PocketMax™.

When using direct commands from a PC, send the $JAPP command to view the current application. $>JAPP,WAASRTKB,RTK,1,2 should appear. This indicates that the WAASRTKB application is active and RTK is the secondary application.

If the response is different and RTK is first, such as $>JAPP,RTK,WAASRTKB,2,1, then a $JAPP,other should be sent, this will swap applications so that the WAAS RTKB application is used.

1. Make sure the communication cable (part number 051-0160) is connected to either PORT-A or the USB DATA COM port of the R220 receiver.
2. With WAASRTKB or RTK as the active application, the R220 automatically configures messages on Port B of the receiver for correct RTK operation. The baud rate of Port B will also be automatically set to 9600.

Connecting the R220 to a Base Station or Rover Via Cable - The steps in the preceding section allows the R220 receiver to be used as a base station or rover either with or without a radio connection.

To use a wired connection:

1. Connect the R220 to the base station, or rover, with a 9-pin serial cable from Port B of the base station to Port B of the rover receiver using a null modem adaptor.

Connecting the R220 Via a Wireless Connection - The R220 can be connected through a wireless connection. The wireless connection must meet these requirements:

- Non-interference with GPS
- Serial connection set to 9600,N,8,

1

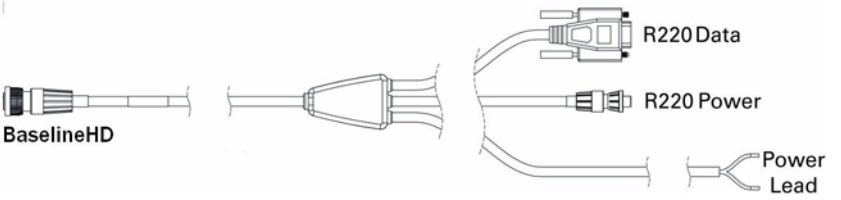


Figure 4-3. BaselineHD rover radio cable

Note: Hemisphere GPS recommend testing with a wired condition prior to using a third party wireless connection.

Note: Make sure both the rover radio and base station are on the same channel or frequency in order for the rover radio to receive corrections from the base station.

Operation

The R220's status LEDs indicate the following:

- Yellow: tracking GPS.
- Flashing green: differential has been attained, but the residual has not met the threshold.
- Solid green: RTK lock.

The R220 will output standard NMEA messages through Port A. Set the message and port output as required by the user-supplied interface.

Using OmniSTAR

OmniSTAR is a worldwide terrestrial DGPS service that provides correction data to subscribers of the system with the use of a geostationary transponder. With this service, the positioning accuracy does not degrade as a function of distance to a base station, as the data content is not composed of a single base station's information, but an entire network's information.

The information broadcast by this service is based upon a network of reference stations placed at geographically strategic locations. The network stations communicate GPS correction data to control centers where it is decoded, checked, and repackaged into a proprietary format for transmission to a geostationary L-band communications satellite. The satellite rebroadcasts the correction information back to earth over a large signal footprint where the R220's L-band differential satellite receiver demodulates the data. The resulting corrections are those that would be calculated if a reference station were set up at the present location. This type of solution ensures a consistent level of accuracy across the entire coverage area.

OmniSTAR Reception

The OmniSTAR service broadcasts at a similar frequency to GPS, and as a result, is a line-of-sight system. There must be a line of sight between the antenna and the OmniSTAR satellite for reception of the service. The OmniSTAR service uses geostationary satellites for communication. The elevation angle to these satellites is dependent upon latitude. For latitudes higher than approximately 55° north or south, the OmniSTAR signal may be blocked more easily by obstructions such as trees, buildings, terrain, or other objects.

OmniSTAR Service Activation

The OmniSTAR service may be activated by contacting the service provider in the your region. Contact OmniSTAR with the unit number and they will activate the subscription over the air. Please have the receiver ready to receive the OmniSTAR signal for subscription validation.

For questions regarding the OmniSTAR service, please contact OmniSTAR for further information.

Contacting OmniSTAR

Table 5-1 provides the contact numbers for the various OmniSTAR offices throughout the world.

Table 5-1: OmniSTAR Contact Information

Location	Telephone Number	Fax Number
North America / South America	+1-888-883-8476 + 1-713-785-5850	+1-713-780-9408
Europe / North Africa / Middle East / West Asia	+1-31-70-317-0900	+31-71-581-4719
Australia / Far East	+61-8-9322-5295	+61-8-9322-4164
Southern Africa	+1-27-21-552-0535	+1-713-780-9408

Appendix A: Troubleshooting

Troubleshooting

Table A-1 provides a checklist to troubleshoot common issues and their solutions for the R220.

Table A-1: Troubleshooting

Issues	Possible solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connections • Check power input voltage (8 - 36 VDC) • Check current restrictions imposed by power source (maximum is 575 mA @ 12 VDC) • Press the POWER button
No data from R220	• Check receiver power status (red LED) • Check integrity and connectivity of power and data cable connections • The volume of data requested to be output by the R220 could be higher than what the current baud rate supports. Try using 19,200 or higher as the baud rate for all devices.
No GPS lock	• Check integrity of cable connections • Verify antenna's clear view of the sky

Table A-1: Troubleshooting

Issues	Possible solution
No SBAS lock	• Check integrity of cable connections • Verify antenna's clear view of the sky • Check SBAS visibility map
No OmniSTAR lock	• Subscription activated and not expired • Check antenna connections • Verify antenna's clear view of the sky

Appendix B: Specifications

R220 Specifications

Table B-1 to B-5 on pages 50 to page 52, provides the power, mechanical, communication, environmental and DGPS specifications for the R220.

Table B-1: Power specifications

Item	Specification
Input voltage	8 to 36 VDC
Power consumption	< 5.5 W @ 12 VDC (typical)
Current consumption	450 mA @ 12 VDC (typical)

Table B-2: Receiver mechanical specifications

Item	Specification
Height	45 mm (1.77 in)
Width	114 mm (4.49 in)
Length	160 mm (6.30 in)
Weight	0.54 kg (1.19 lbs)

Table B-3: Environmental specifications

Item	Specification
Operating temperature	-30° C to +65° C (-22° F to +149° F)
Storage temperature	-40° C to +85° C (-40° F to +185° F)
Humidity	95%, non condensing

Table B-4: GPS sensor specifications

Item	Specification
Receiver type	L1 & L2 channels with carrier phase
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS 3 SBAS or 3 additional L1CA GPS
Update rate	10 Hz standard, 20 Hz avsilsble
Horizontal accuracy	< 0.6 m 95% confidence (DGPS) * < 2.5 m 95% confidence (autonomous) ** 1.5 cm + 1 ppm 95% accuracy (RTK)*
Differential options	SBAS, L-Dif, L-Band, Autonomous, External RTCM, RTK, OmniSTAR (HP/XP)
SBAS tracking	3-channel, parallel tracking
Cold Start up time	<60 s
Warm Start Time 1	30 s (valid ephemeris)
Warm Start Time 2	30 s (almanac and RTC)
Hot Start Time	10 s typical (valid ephemeris and RTC)
Satellite re-acquisition	< 1 s

* Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for local services) and ionospheric activity

**Depends on multipath environment, number of satellites in view, satellite geometry and ionospheric activity.

Table B-5: Communication specifications

Item	Description
Serial ports	2 full duplex RS232, 2 USB
Pulse output	1 PPS (HCMOS, active high, rising edge sync)
Baud rates	4800 - 115200
Differential correction I/O protocol	RTCM SC-104, Hemisphere GPS proprietary
Data I/O protocol	NMEA 0183 and Hemisphere GPS binary and RTCM
Event mark output	HCMOS, active low, falling edge sync, 10 k-ohm

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